

**IMAGE (Imager for Magnetopause-to-Aurora  
Global Exploration)  
LENA (Low Energy Neutral Atom)  
User's Guide**

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Goddard Space Flight Center  
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# **LENA Data Processing System User's Guide**

March 28, 2003

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# **1. Introduction**

## ***1.1 Purpose and Scope***

This document provides instructions on how to setup and how to execute the Low Energy Neutral Atom (LENA) Data Processing Software (LDPS). It also provides a high level description of the external software applications it interfaces with and some basic instructions on how to run those external applications.

This document assumes the user has basic knowledge of the UNIX system and the Universal Data Format (UDF) data formats.

## ***1.2 LENA Data Processing Software Overview***

The LDPS provides routine daily and customizable plots for quantitative and qualitative analysis of the LENA data. A daily cron job downloads the latest UDF data files from the IMAGE data delivery system. The script then executes the Interactive Data Language (IDL) routines to generate the summary plots and text dumps. The output products reside in the data archive specified by the user in the setup files (see section 4.1). User's may also chose to generate plots via the web interface or use the interactive mode, described in sections 3.5 and 3.6, respectively.

## 2. Getting Started...Installing the Software

### 2.1 *Logging onto Goewin*

#### 2.1.1 Secure Shell (SSH)

User's will need to use the SSH application to remotely log onto the LENA machine, `goewin.gsfc.nasa.gov`, from their workstation. The user must provide goewin's system's administrator with the client machine's IP address.

#### 2.1.2 User Account

The user account *lenadev* owns all of the LDPS software and output product directories. Contact the system's administrator for the password.

### 2.2 *Permissions*

The *lenadev* account must have read, write, and/or execute permissions to the following directories and subsequent lower level directories:

- `/archive4/PRODUCTS`
- `/archive4/UDFDATA`
- `/archive4/UDFBundles`
- `/archive4/stage`
- `/archive4/LenaSW`

### 2.3 *Setting up the Environment*

#### 2.3.1 Interactive Data Language (IDL) Licenses

In order to access IDL development licenses, include the following line in the .cshrc file.

```
setenv LM_LICENSE_FILE /usr/local/rsi/license/bonnethead.lic:/usr/local/rsi/license/hammerhead.lic
```

The LENA web server, on Goewin, has its own dedicated IDL license.

### 2.3.2 LENA Environment Variables

In order for LDPS to interface with external software components, the following environment variables need to be defined. The LENA environment file, lена\_env, resides in /archive4/LenaSW/LenaUDF. The file contents are as follows:

```
#####
LENA ENVIRONMENT SETUP
#####
setenv  UDFPKGS_HOME      /archive4/LenaSW/LenaUDF

setenv  UDF_HOME          $UDFPKGS_HOME/udf
setenv  GPH_HOME          $UDFPKGS_HOME/gph
setenv  UDFTOOL_HOME      $UDFPKGS_HOME/UDFTools
setenv  UDF_DATA          /archive4/UDFDATA
setenv  XLIB              /usr/openwin/lib/libX.so
setenv  UDFDLM_DIR        /archive4/LenaSW/LenaUDF/udf_dlm/UDFToIDL

set path = ($path $UDFTOOL_HOME/bin $UDF_HOME/bin)
setenv  IDL_DIR           /usr/local/rsi/idl_5.3
#####
```

Note: If the location of the external software changes, its corresponding environment variable(s) must also change.

Add the following line to the .cshrc file:

```
source /archive4/LenaSW/LenaUDF/lenя_env
```

To update and check the environment:

```
% source .cshrc
% env
```

### 2.3.3 External Software Components

#### 2.3.3.1 UDF Software

The UDF software provides a mechanism to read and process UDF data formats. Chris Gurgiolo, [chris@gurgiolo.com](mailto:chris@gurgiolo.com), of Bitterroot Basic Research developed the UDF software and UDF-Dynamic Load Module (DLM), also referred to as UDFToIDL.

First, create the following directories:

1. Create the UDF software directory. For example purposes, this document will call this directory `your_UDF_directory`.
2. Create the LDPS software directory. For example purposes, this document will call this directory `your_LDPS_software_directory`.

Please see the UDF manual for more detailed information regarding the UDF software, <http://lena.gsfc.nasa.gov/lenaDEV/html/MiniWeb/Index.html>

Please note that the UDF software has already been installed on Goewin in `/archive4/LenaSW`. The following sections describe the steps needed to re-install the software from scratch, if the need arises.

##### 2.3.3.1.1 Installing the UDF Administration Tool

1. Start a web browser and go to <http://image.gsfc.nasa.gov>
2. Click on the IMAGE Software Archive link under the IMAGE Data and Ancillary Products section
3. Click on the UDF software link
4. Click on the latest version of `ADMIN.#.#r#.tar.gz`
5. Close the web browser and open a terminal session
6. `% mv ADMIN.#.#r#.tar.gz your_UDF_directory`
7. `% cd your_UDF_directory`
8. `% gunzip ADMIN.#.#r#.tar.gz`
9. `% tar xvf ADMIN.#.#r#.tar`
10. `% AdminINSTALL.tcl`

##### 2.3.3.1.2 Installing the full UDF software package

1. Start a web browser and go to <http://image.gsfc.nasa.gov>
2. Click on the IMAGE Software Archive link under the IMAGE Data and Ancillary Products section
3. % mv FULLUDF.#.#X.tar your\_UDF\_directory/UDFTools/PKGS
4. %UDFAdmin
5. Click the FULL\_INSTALL button in the upper right hand corner of the window
6. Choose EXPERIMENTAL from menu
7. Click the Quit button

#### 2.3.3.1.3 Creating a UDF Data Tree

1. % UDFAdmin&
2. Click CREATE UDF DATA TREE
3. Select PROJECT = IMAGE  
MISSION = IMAGE1  
EXPERIMENT = LENA
4. Click the PROCESS button
5. Repeat step #3 and replace MISSION = IMAGE1Q
6. Click the PROCESS button
7. Close the CREATE UDF DATA TREE window
8. Click the Quit button
9. % cd UDFDATA
10. % mkdir PKGS

#### 2.3.3.2 UDF-DLM (Dynamic Load Module)

The UDF-DLM provides a simple interface between the UDF and IDL applications. Please see the UDF-DLM README file for instructions on compiling the C routines. The UDF-DLM software and README files reside in \$UDFDLM\_DIR. If necessary, to download the software:

1. Open a web browser and go to <http://image.gsfc.nasa.gov>
2. Click on the IMAGE Software Archive link under the IMAGE Data and Ancillary Products
3. Look for and click on the link for Gurgiolo's version of the UDF DLM software for IDL
4. Click on the latest version of UDFToIDL.#.#r#.tar.gz

5. Close the browser and open a window session
6. % gunzip UDFToIDL.#.#r#.tar.gz
7. % tar xvf UDFToIDL.#.#r#.tar
8. Follow the directions in the README file to compile
9. % mv udf.dlm your\_LDPS\_software\_directory
10. % mv udf.so your\_LDPS\_software\_directory

## 2.4 *Obtaining the LENA Software*

The LENA tested and validated software resides on goewin in /export/home/rwest/lena/approved-modules. This directory includes all of the tested IDL \*.pro files, Fortran and C modules, UDF libraries, run-time setup files, and the IDL and Fortran/C compilation files.

### 3 Downloading and Installing the UDF Data

Each morning, a cron job automatically downloads the UDF data from the IMAGE data delivery system. The data are installed onto the UDF database located in \$UDF\_DATA. If the UDF data bundles are missing or corrupted, manual data downloads and installs are required.

#### 3.1 *Installing Plot Interface Data Format (PIDF) and Virtual Interface Data Format (VIDF) files onto Goewin*

These files are already installed in the UDF database. These files do not need to be re-installed unless updates have been made to the files. The version number in the filename indicates if updates have been made. The following are instructions on how to download and install the PIDF and VIDF.

1. In a web browser, go to the IMAGE data delivery system:  
[http://150.144.211.77/image/image\\_main.html](http://150.144.211.77/image/image_main.html). Follow the instructions on the web page.
2. Select IMAGE.IMAGE1.UDFp.#####.tgz and  
IMAGE.IMAGE1.UDFv.#####.tgz
3. Close the browser window and open a window session
4. % UDFAdmin &
5. In the UDF window, click ADD UDF DATA
6. Select the UDFp and UDFv files
7. Click the PROCESS button
8. Close ADD UDF DATA window
9. Click REBUILD VIDFS
10. Select PROJECT = IMAGE  
MISSION = IMAGE1  
EXPERIMENT = LENA
11. Click the PROCESS button
12. Close, but don't quit the UDFAdmin tool
13. Move to a window session
14. % cp \$UDF\_DATA/IMAGE/IMAGE1/PIDFS/\*  
\$UDF\_DATA/IMAGE/IMAGE1Q/PIDFS
15. % cp \$UDF\_DATA/IMAGE/IMAGE1/VIDFS/\*  
\$UDF\_DATA/IMAGE/IMAGE1Q/VIDFS
16. Move back to the UDFAdmin Tool REBUILD VIDFS window
17. Repeat step #10 and #11 and replace MISSION = IMAGE1Q in step #10

18. Close the REBUILD UDF window
19. Click the Quit button

### **3.2     *Uploading Modified PIDE/VIDF files to the IMAGE Data Delivery System***

If the PIDEs/VIDFs have been modified, these files must be updated at the IMAGE Data Delivery System, also referred to as the SMOC:

1. Go to the SMOC website, <http://150.144.211.77>
2. Click on the 'File uploads' button in the left hand column
3. Username : Image\_SI
4. Password : 7adams7
5. Click on Login
6. upload the PIDE/VIDF file

The SMOC will automatically locate the updates and install them onto its local database. New VIDF/PIDE bundles are generated and will be made accessible via the SMOC web site for future downloads.

### **3.3     *Manually Downloading and Installing the UDF Data Bundles***

#### **3.3.1     Downloading UDF Bundles for the Current Year**

The following web site stores UDF data bundles for the current year.

1. For current data, in a web browser, go to the IMAGE data delivery system: [http://150.144.211.77/image/image\\_main.html](http://150.144.211.77/image/image_main.html). Follow the instructions. For old data, in the web browser, go to the IMAGE data delivery system, [http://150.144.211.77/image/image\\_main.html](http://150.144.211.77/image/image_main.html), in the lower left hand corner under FTP sites, click on the nssdcftp.gsfc.nasa.gov. Follow the directory links to the LENA UDF data or follow section 3.3.2 to ftp from the command line instead.
2. `% mv UDF_data_bundle $UDF_HOME/PKGS`  
Note: IF and ONLY if the data bundles were downloaded from the IMAGE data delivery system in **batch**, then the following must also be executed (where the zipped\_tar\_file is a unique filename created by the SMOC for this particular download bundle):

```
% gunzip zipped_tar_file
% tar xvf zipped_tar_file
```

3. %UDFAdmin
4. Click on ADD UDF DATA
5. Select the desired UDF data bundles to install by clicking the file name.
6. Click the PROCESS button in the upper right hand corner of the window.
7. Once the install is completed, the window session will return.
8. Click the Quit button.

### 3.3.2 Downloading UDF Bundles from Previous Years

The following ftp site hosts UDF data bundles for previous years.

1. % ftp nssdcftp.gafc.nasa.gov
2. username: anonymous
3. password: your\_email\_address
4. cd /spacecraft\_data/image/LENA/UDF/year\_you\_are\_interested\_in

Special Note: The National Space Science Data Center (NSSDC) does not have the following UDF data bundles available:

March 29, 2000 (89) through April 20, 2000 (111)  
June 18, 2000 (170) and June 19, 2000 (171)

## 4 LDPS

### 4.1 LENA Setup Files

The LENA setup files are run time files that can be modified to change processing and plotting options. Please read the contents of the setup files for specific selections. These files are located in your `_LDPS_software_directory` and should have been copied with the software. See Section 2.4. All available options include default values, except for the start/stop date and time. The user must enter these parameters.

There are separate setup files for each specific plot format. The plot types currently available are:

<code>l_apo.setup</code>	apogee plots
<code>l_per.setup</code>	perigee plots
<code>l_zc1.setup</code>	health and safety plots
<code>l_zc2.setup</code>	singles start/stop and valid event spectrograms
<code>l_zc3.setup</code>	image browse product
<code>l_hob.setup</code>	Hydrogen, Oxygen, Background Plots
<code>l_zse.setup</code>	Event Text dumps
<code>l_psc.setup</code>	Power Supply Command Text Dump
<code>l_psm.setup</code>	Power Supply Monitor Text Dump
<code>l_ltt.setup</code>	Long Term Trending Plots, Sun Pulse
<code>l_mspect.setup</code>	Mass Spectrum Plots, Event TOF Data
<code>l_stab.setup</code>	State Table Text Dumps

### 4.2 LENA IDL Makefile

The IDL Makefile, `create_lena_plots`, is a file that compiles the LDPS files and starts the LDPS software. This file is available in your `_LDPS_software_directory`. See Section 2.4.

### 4.3 LENA C/Fortran to IDL Makefile

The compile\_t96 compiles the Fortran and C code to generate a shared object file. This should be executed before running the LENA software. Please see section 2.4 for the location of these files.

```
% cd your_LDPS_software_directory
% compile_t96
```

#### **4.4    *Production Data Processing***

A production script file is run every morning at 3:00 AM. This script is written in PERL and is called lena\_production.pl. When run, this script calls up other scripts which actually does the processing. The processing is done in three 3 steps. All production scripts are found in /archive4/PRODUCTS/downloads.

1) Downloading unprocessed data:

A check is made at the ftp data site 150.144.211.77 for any quick look and definitive \*.tgz data files or OA files and \*.lz.gz data files and clock drift file (clockdrift.asc) that have a creation data of "yesterday". A list is made of the files that meet this criteria and they are ftped to /archive4/PRODUCTS/downloads.

2) Installing the data so it can be accessed:

install\_data.pl

Checks the directory /archive4/PRODUCTS/downloads for any \*.tgz and \*.lz.gz files that were downloaded in step 1. If any are found they are unzipped and put in the appropriate directories:  
/archive4/UDFDATA/IMAGE/IMAGE1 for the definitive \*.tgz,  
/archive4/UDFDATA/IMAGE/IMAGEQ for the quick look \*.tgz,  
/archive4/LZDATA/yyyy/def for the definitive \*.lz.gz and  
/archive4/LZDATA/yyyy/ql for quick look \*.lz.gz. The latest clock drift file is left in /archive4/PRODUCTS/downloads. If any \*.tgz data files were installed the date is put in a file called spectrogram\_date.list in the form of yyyymmdd in ascending order with the quick look dates first followed by the definitive dates.

3) Creation of production products:

spectrograms.pl

Using IDL, a standard 24 hour color spectrogram and event rate line plot are created for each date in the spectrogram\_date.list file. A GIF file and a postscript file are created for each, the postscript is converted to PDF format and is then deleted. The line plot file names are of the form lyymmddhhmmhhmm\_sumln0.gif (PDF) and the spectrogram file names are of the form lyymmddhhmmhhmm\_sumsp0.gif (PDF). The GIF and PDF files are then moved to /archive2/PRODUCTS/dev\_Daily/spectrograms/yyyy/Mon based on the date of the date of the data plotted. An ASCII data file of the power supply information is also created and is moved to /archive2/PRODUCTS/dev\_Daily/pwr\_sup/yyyy/Mon based on the date of the data.

#### sunpulse\_spectrograms.pl

Using IDL, a standard 24 hour sun pulse centered color spectrogram plot is created for each date in the spectrogram\_date.list file. A GIF file and a postscript file are created for each, the postscript is converted to PDF format and is then deleted. The spectrogram file names are of the form lyymmhhmmhhmm\_sumsp0.gif(PDF). The GIF and PDF files are then moved to /archive2/PRODUCTS/dev\_Daily/sun\_pulse/yyyy/Mon based on the date of the date of the data plotted.

#### perigee\_spectrograms.pl

Using IDL, a 2 hour color spectrogram plot is created centered at each perigee for each date in the spectrogram\_date.list file. A GIF file and a postscript file are created for each, the postscript is converted to PDF format and is then deleted. The spectrogram filenames are of the form lyymmhhmmhhmm\_per0.gif(PDF). The GIF and PDF files are then moved to /archive2/PRODUCTS/dev\_Daily/perigee/yyyy/Mon based on the date of the data plotted.

#### hk\_plots.pl

Using IDL, 3 24 hour line plots are created of the house keeping data for each date in the spectrogram\_date.list file. A GIF file and a postscript file are created for each, the postscript is converted to PDF format and is then deleted. The line plot file names are of the form

lyymmhhmmhhmm\_hsk0(1,2).gif(PDF). The GIF and PDF files are then moved to archive2/PRODUCTS/dev\_Daily/hk/yyyy/Mon based on the date of the data plotted.

statetable.pl

Using IDL, an ASCII file is generated which contains a timeline of information of the state of the instrument for each date in the spectrogram\_date.list file. A file is created for each date. The ASCII file names are of the form lyymmhhmmhhmm\_st0.dmp. The ASCII file is then moved to /archive2/PRODUCTS/dev\_Daily/state\_tables/yyyy/Mon based on the date of the data in the file.

event\_dumps.pl

Using IDL, an ASCII file is generated which contains the event data for each date in the spectrogram\_date.list file. A file is created for each date. The ASCII file names are of the form lyymmhhmmhhmm\_ev0.dmp. The ASCII file is then moved to /archive2/PRODUCTS/dev\_Daily/event\_dmps/yyyy/Mon based on the date of the data in the file.

## 4.5 *Command Line Data Processing and Custom Plot Generation*

### 4.5.1 Executing the LENA software

1. % idl
2. IDL> @create\_lena\_plots  
... a bunch of compilation messages...  
l\_lenaplot  
setup file name > l\_zc2.setup /\* type in the setup file name \*/  
IDL > exit

## 4.6 *Web Interface*

To generate a custom plot via the web interface:

1. Start a web browser and go to <http://lena.gsfc.nasa.gov/>
2. Select Custom Plots from the menu bar
3. Select the desired plot option link
4. Fill in the template
5. Click the Submit button

To use the zoom capability, click on an area in the 24-hour spectrogram plots. A form with the selected information for that data period will be displayed in a separate web browser. Click submit to generate a plot for that time period.

Help pages are available as a link on the query template that describes each parameter and option. The web output products reside in /archive4/stage.

## 5 Output Data Files

The LDPS generates the following output files:

1. If running locally using the lenadev user account, the output products: a spectrogram, a line plot, or a text dump will be written to the location specified by the `l_prod_dst` field in the setup file.
2. If generating plots via the web interface, the output products are written to `/archive4/stage`. The specific products are uniquely identified by a unique user process id. This id is appended to the end of the file.
3. If running the production code, the output products reside in `/archive4/PRODUCTS`. The plots and text dumps are separated by product type, year, and month.

## 6 LENA Troubleshooting

**Problem:** UDF indicates there is no data or core dumps

**Try:**

- checking the UDF DB for duplicate data files, if so remove them using dBAsk (See UDF manual for more information)
- checking the UDF DB for the data file, if not available, download data file and install (See section 3)
- using dBAsk, check that the files are available in the UDF DB for that time period. Check the begin and end time. Make sure that each data bundle ONLY contains one day's worth of data. If the data file spans more than one day, the file is corrupted. Delete the problem file from the DB using dBAsk. Download a new UDF bundle and install (See Section 3). If the problem still persists, contact the IMAGE Data Delivery System Engineer, Rick Burley.
- checking that the udf.dlm and udf.so libraries for the UDF-DLM are accessible within the LDPS directory (See section 2.2.3.2)

**Problem:** Error installing a UDF data bundle

**Try:**

- checking for write permissions for the lenadev account to the \$UDF\_DATA directory, then reinstall
- checking the binary version of the VIDF definition for the data packet in question:

For example (if IMLROISM was the problem bundle):

```
% read_vidf IMAGE IMAGE1 LENA LENASCI IMLROISM
```

This will provide the contents of the VIDF file that the UDF kernel sees.

If the contents are not correct, then

1. use an editor to correct the contents of the VIDF file
2. convert the VIDF to binary by executing MkBinVidf file name, this executable is found in \$UDFPKGS\_HOME/udf/bin
3. rebuild the UDF DB, using the UDFAdmin tool

**Problem:** UDF not swapping the data during data installation

**Try:**

- Forcing the swap (using IMLROISM as an example):

```
% cd $UDF_HOME/src/udf_swap
```

```
% make UNIX ; make UNIXrelease
```

```
% udf_swap IMLROISM19980010000I IMLROISM20010262359D  
IMLROISM20010262359H
```

**Problem:** RAIDS crash, restore integrity of UDF DB:

**Try:**

% dBAsk&

- 1 select the PROJECT, MISSION, INSTRUMENT, etc.
- 2 click on the CLEAN button
- 3 click the Quit/Close button

% UDFAdmin&

1. Click on REBUILD UDF DATABASE

**Problem:** UDF data available, but not getting complete data set

**Try:**

%dBAsk&

1. select the PROJECT, MISSION, INSTRUMENT, etc.
2. fill in the start and stop date/time
3. select Query from menu in the upper left corner of the window
4. click Process
5. determine if there are duplicate files for a specific date, if so remove the older files by:
  - a. selecting the files to delete
  - b. select Delete from the menu in the upper left corner of the window
  - c. click process

**Problem:** UDF\_EOF: (ReOpenFile): FILE\_POS or A NEXT\_FILE\_STATUS OPEN ERROR or any other problems related to the UDF Data

**Try:**

1. Check the UDF MiniWeb for a description of these error messages at <http://lena/lenaDEV/html/MiniWeb/Index.html>
2. If error message definitions are not sufficient in describing the corrective approach, execute the UDF Database Query application:

% dBAsk&

- a. In dBAsk, select the MISSION, PROJECT, INSTRUMENT, etc... information from the pull down menus.
- b. In the bottom area of the window, input the start and stop time range of data to view
- c. In the upper left hand corner of the window, select Query from the pull down menu
- d. In the upper right hand corner of the window, select the Process button
- e. A list of the available files currently in the database will appear in the window
- f. Go through the list and check for duplicate files or files with start times that overlap each other, for example

IMLSNGLS 2000 18 23:58:17.926 to 2000 19 23:59:10.123  
IMLSNGLS 2000 19 00:01:15.367 to 2000 19 23:59:59.021

NOTE: Because of the spacecraft drift, the files start time begin at the end of the previous day. In this above example, we are actually looking at day of year 19 in 2000. In the second IMLSNGLS 2000 19 00:01:15.367, we can see that this start time occurs later than the first file. The first file includes more data. These two file times overlap and MAY cause the ReOpenFile and/or the NEXT\_FILE\_STATUS problem. Therefore, delete the second version.

3. If there are missing data files, go to the NSSDC ftp site to download the UDF bundles and reinstall. See section 3.3.2.

## Acronyms

GIF	Graphics Interchange Format
GSFC	Goddard Space Flight Center
IDL	Interactive Data Language
IMAGE	Imager for Magnetopause-to-Aurora Global Exploration
LDPS	LENA Data Processing System
LENA	Low Energy Neutral Atom
NASA	National Aeronautics and Space Administration
NSSDC	National Space Science Data Center
OA	Orbit and Attitude
PDF	Portable Data Format
PERL	Practical Extraction and Report Language
PIDF	Plot Interface Definition File
QL	Quicklook data
SMOC	GSFC Science and Mission Operations Center
SSH	Secure Shell
UDF	Universal Data Format
UDF-DLM	Universal Data Format - Dynamic Link Module
URL	Uniform Resource Locator
VIDF	Virtual Interface Definition File
WWW	World Wide Web